



# UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE  
United States Patent and Trademark Office  
Address: COMMISSIONER FOR PATENTS  
P.O. Box 1450  
Alexandria, Virginia 22313-1450  
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/995,421	11/27/2001	Won-Young Chung	5649-909	1882
20792	7590	06/06/2006	EXAMINER	
MYERS BIGEL SIBLEY & SAJOVEC			GEBRESILASSIE, KIBROM K	
PO BOX 37428			ART UNIT	PAPER NUMBER
RALEIGH, NC 27627			2128	

DATE MAILED: 06/06/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

<b>Office Action Summary</b>	<b>Application No.</b> 09/995,421	<b>Applicant(s)</b> CHUNG ET AL.	
	<b>Examiner</b> Kibrom K. Gebresilassie	<b>Art Unit</b> 2128	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 11 October 2005.
- 2a) ☐ This action is **FINAL**.                      2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1-35 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-35 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
     Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
     Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All    b) ☐ Some \*    c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- |  |   |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)  | 4) <input type="checkbox"/> Interview Summary (PTO-413)<br>Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)                                   | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152)             |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)<br>Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____  |

**DETAILED ACTION**

1. In view of the Pre-Appeal Brief filed on March 3, 2006, PROSECUTION IS HEREBY REOPENED. A new ground of rejection is made in view of US Patent No. 6,199,029 issued to Ohta et al.
2. Applicant's request for reconsideration of the finality of the rejection of the last Office action is persuasive and, therefore, the finality of that action is withdrawn.
3. The amendment for specification filed on March 03, 2006 is acknowledged and entered.

***Claim Rejections - 35 USC § 103***

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

4. Claims 1-27 are rejected under 35 U.S.C. 103(a) as being unpatentable over US Patent No. 6,014,943 issued to Arami et al in view of US Patent No. 6,199,029 issued to Ohta et al.

**As per Claim 1:**

Arami discloses a method of estimating characteristics of a plasma contained in a reaction chamber of a plasma reactor including a plurality of magnets that move with respect to the reaction chamber (Fig. 2), the method comprising:

obtaining configuration and process condition data for the reaction chamber (col. 8 lines 9-21);

for each of a plurality of cross-sections of the reaction chamber from the configuration and process condition data (col. 1 lines 21-25; col. 5 lines 5-6); and

generating a generalize model of the plasma from the computed plasma characteristics for the plurality of cross-sections (col. 8 lines 60-64; col. 10 lines 39-43).

Arami fails expressly to disclose computing plasma characteristics.

Ohta discloses computing plasma characteristics (col. 7 lines 54-58).

It would have been obvious to one of ordinary skill in the art at the time of the invention was made to combine the teachings of Arami related to a plasma process device for applying various plasma processes such as an etching process, to a substrate with the teachings of Ohta related to a process simulation method and system applicable to semiconductor device fabrication and more particularly, to a topography simulation method and system of a plasma-assisted etching process that employs the well known Monte Carlo Method. The motivation for doing so would have been more

Art Unit: 2128

convenient to provide a topography simulation method and system of plasma-assisted etching process that has an improved simulation accuracy compared with conventional simulation method (col. 4 lines 54-58). Hence a skilled artisan having access to the teaching of Arami and Ohta would have knowingly modified the teaching of Arami with Ohta.

**As per Claim 2:**

Arami discloses the plurality of moving magnets rotate about an axis of rotation, and wherein each of the plurality of cross-sections includes the axis of rotation (Fig. 9).

**As per Claim 3:**

Ohta discloses computing electron density and temperature for the cross-section using an iterative Monte Carlo computational procedure (col. 3 lines 10-11; col. 3 lines 49-52); and computing ion and neutral species transmission phenomena for the cross-section from a plasma dynamics simulation (abstract).

**As per Claim 4:**

Ohta discloses computing the ion and neutral species transmission phenomena for the cross-section from a plasma dynamics simulation comprises computing solutions to a continuity equation and Poisson's equation for the ion and neutral species (col. 7 lines 48-52).

**As per Claim 5:**

Arami discloses determining a static magnetic field generated by the moving magnets, and wherein computing plasma characteristics for each of a plurality of cross-sections of the reaction chamber (col. 1 lines 21-25; col. 5 lines 5-7) comprises

Art Unit: 2128

computing the plasma characteristics for each of the plurality of cross-sections (col. 1 lines 21-25; col. 5 lines 5-7) from the determined static magnetic field, shape information for the reaction chamber, and plasma collision reaction data (col. 1 lines 26-35).

**As per Claim 6:**

Ohta discloses generating a generalized model of the plasma from the computed plasma characteristics for the plurality of cross-sections comprises computing at least one of an electron density distribution, a temperature distribution, a distribution of ion species, a distribution of neutral species, and a flux incidence (col. 7 lines 55-59).

**As per Claim 7:**

Arami discloses generating a generalized model of the plasma from the computed plasma characteristics for the plurality of cross-sections comprises averaging the computed plasma characteristics for each of the plurality of cross-sections (col. 1 lines 21-25; col. 5 lines 5-6).

**As per Claim 8:**

Arami discloses estimating an etching rate for a wafer positioned in the chamber from the generalized model of the plasma (col. 10 lines 60-61).

**As per Claim 9:**

Arami discloses the plasma reactor comprises a dipole ring magnet (DRM) plasma reactor (Abstract).

**As per Claims 10 and 19:**

The limitations of Claims 10 and 19 have already been discussed in the rejection of Claim 1. They are therefore rejected under the same rationale.

**As per Claims 11 and 20:**

The limitations of claims 11 and 20 have already been discussed in the rejection of Claim 2. They are therefore rejected under the same rationale.

**As per Claims 12 and 21:**

The limitations of Claims 12 and 21 have already been discussed in the rejection of Claim 3. They are therefore rejected under the same rationale.

**As per Claims 13 and 22:**

The limitations of Claims 13 and 22 have already been discussed in the rejection of Claim 4. They are therefore rejected under the same rationale.

**As per Claims 14 and 23:**

The limitations of Claims 14 and 23 have already been discussed in the rejection of Claim 5. They are therefore rejected under the same rationale.

**As per Claims 15 and 24:**

The limitations of Claims 15 and 24 have already been discussed in the rejection of Claim 6. They are therefore rejected under the same rationale.

**As per Claims 16 and 25:**

The limitations of Claims 16 and 25 have already been discussed in the rejection of Claim 7. They are therefore rejected under the same rationale.

**As per Claims 17 and 26:**

The limitations of Claims 17 and 26 have already been discussed in the rejection of Claim 8. They are therefore rejected under the same rationale.

**As per claims 18 and 27:**

The limitations of Claims 18 and 27 have already been discussed in the rejection of Claim 9. They are therefore rejected under the same rationale.

5. Claims 28-35 are rejected under 35 U.S.C. 103(a) as being unpatentable over US Patent No. 6,014,943 issued to Arami and US Patent No. 6,199,029 issued to Ohta et al as applied to claims 1-27 above, and further in view of Applicants Own Admission, herein referred as AOA.

**As per Claim 28:**

AOA discloses a method of simulating plasma in a plasma apparatus having a plasma reactor and a plurality of paramagnet magnets which are asymmetrically arranged and rotate around plasma reactor at predetermined speed, comprising the steps of: (a) inputting shape and process conditions and inputting plasma collision reaction data; (c) computing electron density and temperature and interpreting the transmission phenomenon of ion and neutral species using the data of the steps (a) and (b) until they are converged; and (d) obtaining overall plasma characteristics using the converged values (specification, page 1 lines 19-20 and continue to page 2 lines 1-11).

**As per Claim 29:**

Arami discloses plasma simulation at 2-dimensional cross-sections for cross-sectional magnetic field distribution in a characteristic magnetic field direction (Fig. 9).

**As per Claim 30:**



Arami discloses 2-dimensional plasma simulation is performed for a plurality of 2-dimensional cross-sections including an axis, obtains convergence values for the respective cross-sections, and averages them to obtain plasma characteristics (Fig. 2).

**As per Claim 31:**

Arami discloses DRM plasma apparatus (Abstract).

**As per Claim 32:**

The limitation of claim 32 has already been discussed in the rejection of claim 28. It is therefore rejected under the same rationale.

**As per Claim 33:**

The limitation of claim 33 has already been discussed in the rejection of claim 29. It is therefore rejected under the same rationale.

**As per Claim 34:**

The limitation of claim 34 has already been discussed in the rejection of claim 30. It is therefore rejected under the same rationale.

**As per Claim 35:**

The limitation of claim 35 has already been discussed in the rejection of claim 31. It is therefore rejected under the same rationale.

**Conclusion**

1. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

*US Patent No. 5,421,934 issued to Misaka et al.*

*M. Armacost, P. D. Hoh, R. Wise, W. Yan, J.J. Brown, J. H. Keller, G. A. Kaplita, S. D. Halle, K. P. Muller, M. D. Naeem, S. Srinivasan, H. Y. Ng, M. Gutsche, A. Gutmann, and B. Spuler, "Plasma-etching processes for ULSI semiconductor circuits", IBM, Volume 43, Numbers 1/2, 1999.*

*T. Ohiwa, I. Hasegawa, and M. Sekine, "A New High Density Plasma Etching System Using A Dipole-ring Magnet (DRM)", 1993 IEEE.*

2. Any inquiring concerning this communication or earlier communication from the examiner should be directed to Kibrom K. Gebresilassie whose telephone number is (571) 272-8571. The examiner can normally be reached on Monday-Friday, 8:30 am to 4:30 pm. If attempts to reach the examiner by telephone are unsuccessful, the examiner supervisor, Kamini shah can be reached at (571) 272-2279. The official fax number is (571) 273-8300. Any inquiring of a general nature relating to the status of this application should be directed to the group receptionist whose telephone number is (571) 272-3700.

**Kibrom K. Gebresilassie**  
Patent Examiner  
U.S. Patent and Trademark Office  
Simulation and Emulation, Art Unit 2128  
401 Dulany St., Room 5C25 (Randolph)  
Alexandria, VA 22314-5774  
Tel: 571-272-8571  
Kibrom.gebresilassie@uspto.gov

  
**KAMINI SHAH**  
**SUPERVISORY PATENT EXAMINER**